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TI: Integrated Geophysical Characterization of a NAPL-Contaminated Site Using Borehole and Laboratory Measurements
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AB: We present preliminary results from an on-going geophysical investigation of the former DOE Pinellas site in Pinellas County, Florida, a site with confirmed NAPL contamination. The goal of this work was to demonstrate the combined use of high-resolution crosswell seismic and crosswell radar data for characterization of NAPL distribution in near-surface environments. Borehole conductivity, gamma, and cone penetrometry measurements provided secondary information to constrain lithology. Tomographic techniques were used to obtain cross-sectional velocity and attenuation maps for both the seismic and radar surveys. Subsequent correlation with gamma log data and core properties allowed mapping of several layers of clay-

rich sediment which could affect both the downward and lateral migration of contaminants. Continuous cores extracted from several locations on site allowed calibration of the rock-physics relationships used in interpretation of both the crosswell and logging data. Although conclusive geophysical evidence of NAPL pools has not yet been obtained, regions of anomalous seismic attenuation were detected. These attenuating regions could not be explained by borehole effects or lithology and may be caused by regions of partial gas or NAPL saturation. To further constrain these hypotheses, several lab-scale experiments are currently being performed to measure the acoustic properties of extracted core sections when saturated with a combination of water and NAPL or water and gas under realistic stress conditions. These ultrasonic P-wave velocity and attenuation measurements are being made on intact cores with soil texture varying between fine sands and silty clayey sands. Toluene and TCE, two NAPLs present at the Pinellas site, are used as experimental contaminants in the core measurements. Velocities for the samples partially saturated with gas are measured during the draining phase. Acoustic measurements made on the cores partially saturated with NAPLs showed significant attenuation but forward modeling will be required to determine whether NAPLs alone could explain the high attenuation observed in the field. Our next set of experiments will examine the degree of attenuation produced by partial gas saturation. Previous experience suggests that attenuation mechanisms based on gas bubbles or scattering from gas-rich regions could explain the very low signal amplitudes observed in the field. However, the large difference in frequency between the lab (~500 kHz) and the field (~5 kHz) measurements necessitates a careful examination of the wave attenuation process before using laboratory measurements as a calibration tool. Possible gas sources include biogenic production from contaminated regions and side-effects from previous remediation procedures. Continuing research will focus on constraining the frequency dependent properties of the attenuating zone through integration of short offset VSP data and the acquisition of laboratory measurements at lower frequencies.
UR: http://pangea.stanford.edu/~jfrank/research/pinellas/pinellas_index.html
DE: 0915 Downhole methods
DE: 0935 Seismic methods (3025)
DE: 1831 Groundwater quality
DE: 5102 Acoustic properties
DE: 5144 Wave attenuation
SC: Tectonophysics [T]
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